

07.73
496842
631

ART. 18. THE MAMMALS OF THE MAZINAW LAKE REGION
OF ONTARIO; THEIR REPRODUCTION AND
POPULATION DYNAMICS*

BY JOHN J. CHRISTIAN
THE WYETH INSTITUTE OF APPLIED BIOCHEMISTRY
PHILADELPHIA, 30, PENNSYLVANIA

I. INTRODUCTION

The mammals of the Mazinaw Lake region of southern Ontario were investigated during the first two weeks of July, 1949, and July, 1950. The following is a report on these investigations.

The region lies in the Canadian Precambrian shield section of Lennox and Addington Counties, Ontario. The particular area covered in this account is a north and south strip about twenty-five miles long following highway 41. The west shore of Mazinaw Lake forms the middle of this strip. The lake itself is seven miles long and from one-half to three miles wide, and is one of the larger lakes in the region. All trap locations were within a mile and a quarter from the highway.

The general elevation varies from 850 to 1,250 feet, rising continuously to the northwest to the Algonquin Park area about sixty miles away. The region falls away to the south to meet the great lakes plains, and to the north to meet the Ottawa River valley. The whole region is rolling and rocky with numerous extensive outcrops and bare spots resulting from extensive glaciation. Lakes are numerous, and the general altitude of the low areas is so nearly the same that the drainage from lake to lake flows down only a slight gradient, resulting in slow-flowing, sluggish streams. These traverse numerous boggy areas, and recent lake or pond fills are numerous. The poorly drained, low areas possess a rich acid soil, while the hillsides and uplands are relatively dry and rocky with a thin, sandy, subacid soil. The hillsides are drained by numerous, small, rocky streams which rapidly go dry under drought conditions. Springs are scarce.

Along the eastern shore of Mazinaw Lake, and extending considerably north and south, is a relatively recent fault reaching a height of 1,450 feet from the lake bottom to its highest point. This is responsible for a series of north and south lakes and bogs, and for forming the main drainage of the Mazinaw region.

Halliday (1937) puts this area in the Algonquin-Laurentides section of

*The mammal specimens upon which this paper is based are deposited in Carnegie Museum.



the Great Lakes-St. Lawrence forest region, which he characterizes as follows: ". . . the bed-rock is part of the great Precambrian Shield of Canada, and consists largely of crystalline limestones (Grenville series), schists, and gneisses of the altered sedimentaries and granite intrusives. The topography is rough and irregular, and glacial deposits of varied character, chiefly of somewhat light texture, cover the greater part. In addition there are some lacustrine deposits from the Nipissing-Great Lakes and Algonquin periods. A podsol type of soil is to be expected, but areas of gray-brown and brown forest soils may be present.

"In this section, white pine probably reached its maximum development in Canada, but extensive lumbering and fire have removed the greater part. Red pine has also been a prominent species, especially on the Algonquin Highlands. In spite of the previous dominance of these species and the presence of intrusive conifers from the boreal forest region, the general character is that of a mixed forest, and the dominant or competitive association is one of sugar maple, yellow birch, hemlock, and white pine. In addition there are varying amounts of basswood, white spruce, balsam fir, beech, (Northern) red oak, elm, white ash, red maple, ironwood, white birch and large-toothed aspen. The composition of this association changes somewhat to the north, as hemlock, (Northern) red oak, and beech decrease numerically and finally drop out before the limits of the Section are reached and the proportion of yellow birch, white spruce, balsam fir, and white birch increases. . . . Throughout the Section, areas of hardwood occur on the ridge tops and on heavier soil deposits, and black spruce, tamarack, and some cedar are found in swampy depressions."

The Mazinaw region fits into Halliday's description for the more northern limits of the Algonquin-Laurentides Section, probably as a result of its altitude. Beech and hemlock are scarce, and the northern red oak is confined to the drier areas. The uplands support a hardwood forest with sugar maple dominant. Cut-over areas have grown up to aspen (both large-toothed and trembling), white birch, red maple, red oak, and some white spruce and fir. Pure conifer stands of white spruce and fir occupy the lower dry areas, while extensive black spruce and tamarack bogs abound. These latter, when cut over, come up in alder and willow. Black ash-white cedar bogs are abundant. About seven miles to the west of Mazinaw Lake there is still a large stand of virgin white pine surrounding Weslemkoon Lake. This stand, in which pines four feet d.b.h. are reportedly common, is being lumbered around its edges at the present time, but only in winter when the logs can be skidded out. Besides these forest

types, there are numerous high "balds" of bare rock alternating with extensive areas of blueberries.

Extensive timbering occurred sixty years ago and the area has been burned over two or three times since, the last fire having taken place about twenty years ago. It is evident at present that white pine will again be the climax forest type, as even now they are beginning to crowd out the aspens and birches on the hillside areas. Pine seedlings of all sizes abound.

A small area of each general forest type was selected for trapping, and as far as possible these areas were chosen so that they were in a continuous habitat of the same type. The following habitats were trapped in, and further discussions of the vegetation will appear under the heading describing the specific area.

I. Dry, rocky, mixed deciduous-conifer woods: deciduous vegetation dominant.

II. Low, wet, deciduous woods with a few patches of conifers, and boggy areas.

III. Black ash-northern white cedar bog.

IV. Dry old field. *Danthonia* dominant.

V. Open *Vaccinium*-sphagnum bog surrounded by spruce and tamarack.

VI. Dominantly deciduous woods with alder bogs and small open sedge bogs.

VII. Small sphagnum-spruce-fir bog in a more extensive mixed woods.

VIII. Open, sedge marsh.

IX. High blueberry bog.

X. Pure, dense, black spruce bog; white spruce and fir on surrounding drier areas.

The climate of the area is classified by Halliday (1937) as temperate and humid plus, with moisture abundant at all seasons. Thirty inches of snow is seldom exceeded at any time. The lowest temperature so far recorded at Mazinaw Lake is 52° below zero F., but ordinarily winter temperatures do not go below -20°F. In 1949, however, drought conditions prevailed for two months from the end of April until the end of the first week in July, with the final forty days without any rain whatsoever. Bogs were for the most part without standing water, and most streams were either totally dry or with only a slight trickle. More normal conditions of precipitation prevailed in 1950, and during the first two weeks of July there was from a foot to eighteen inches of water standing in the bogs which had been dry the previous year.

In 1950 a much colder spring and a later summer prevailed than in 1949. This difference was reflected in the plants. In 1949 the hot, dry spring was from two to three weeks ahead of the colder, wet spring of 1950. Blueberries and *Aralia* berries were ripe by July 1, 1949, but were just beginning to ripen by July 14, 1950, and this difference was true of many other blooms and fruits.

The small mammals were trapped with regular snap-back traps. The bait used was either pure ham-fat rubbed on the trap, or a mixture of ham-fat, peanut butter, and almond extract. Smears of the testis and epididymis were made of each male and were stained with haematoxylin-eosin (Christian, 1950a). The reproductive tracts of the females were preserved entire.

The fur-bearers and large animals were not trapped, although a few in good condition were picked up from the highway. Information regarding these mammals was, for the most part, obtained by questioning local trappers, and residents, and others who were familiar with the local mammals. Most of this information was obtained from Albert Spencer and Irving Brown, both reliable and experienced trappers in the area, and from Fred Garbutt, an interested and observant local resident.

The following account has been divided into four sections: the habitats trapped in, accounts by species, discussion of populations, and information on reproduction and its relation to population dynamics.

II. DISCUSSION OF SPECIFIC HABITATS

Ten habitats were chosen for trapping as being representative of the region, and these are discussed in detail below. All references to habitats following the discussion of a mammal refer to the designating numeral of the specific habitat area.

I. *The dry, rocky, steep hillside of the west shore of Mazinaw Lake, seven miles north of Cloyne, Ontario. Elevation 900 feet. Trapped in 1949 and 1950.*

This area is the dry hillside comprising the west shore of Mazinaw Lake, which is completely wooded except for a few old cleared areas. The forest is primarily deciduous and is composed of sugar maple, aspen, white birch, and some white and red pines. Numerous bare boulders and outcrops of quartzite are scattered through the area providing many cracks and crevices in which small mammals may take refuge. The hillside is well drained. The sandy, thin, and subacid soil has been formed by the breakdown of metamorphosed sandstones. Wild sarsaparilla, wintergreen, bush

honeysuckle, and low sweet blueberry form the principal ground cover. The area was burned and lumbered in the past and now represents a maturing second growth.

The difference in seasons between similar dates in 1949 and 1950 is plainly shown by the various flowering plants. Bunchberry was in berry in 1949, while at the same time in 1950 it was only in full bloom, even in warm, open spots. *Aralia* berries were ripe in 1949, but the plant was just past blooming in 1950. The bush honeysuckle was well past blooming in 1949, but was in full bloom in 1950. Blueberries were ripe the first of July in 1949, but were only beginning to ripen at the end of the second week of July in 1950.

The following is a list of the principal plants of the area. The more dominant forms are preceded by an asterisk in this and all following lists of flora. More than one asterisk indicates that the form is dominant almost to the exclusion of others.

- White pine (*Pinus strobus*)
- Red pine (*Pinus resinosa*)
- Balsam fir (*Abies balsamea*)
- Hemlock (*Tsuga canadensis*)
- *Trembling aspen (*Populus tremuloides*)
- *Large-toothed aspen (*Populus grandidentata*)
- *White birch (*Betula papyrifera*)
- Red oak (*Quercus borealis*)
- *Sugar maple (*Acer saccharum*)
- Red maple (*Acer rubrum*)
- *Smooth-leaved shadbush (*Amelanchier laevis*)
- Moosewood (*Acer pensylvanicum*)
- *Bunchberry (*Cornus canadensis*)—berry, 1949; bloom, 1950.
- *Low sweet blueberries (*Vaccinium pennsylvanicum*)—berry, 1949.
- *Bush honeysuckle (*Diervilla lonicera*)—Bloom, 1950.
- *Wintergreen (*Gaultheria procumbens*)
- Running ground pine (*Lycopodium complanatum*)
- Running clubmoss (*Lycopodium clavatum*)
- Rock polypody (*Polypodium virginianum*)
- Bracken (*Pteridium latiusculum*)
- *Heartleaf lily (*Maianthemum canadense*)—just past bloom, 1950.
- *Fireweed (*Epilobium augustifolium*)—in bloom, 1949 and 1950.
- **Wild sarsaparilla (*Aralia nudicaulis*)—berries ripe, 1949.
- Green pipsissewa (*Chimaphila umbellata*)

A list of the birds found in the area follows. Both the yellow-bellied sapsucker and the least flycatcher were known to be nesting in the immediate area, while the others, if not nesting in the immediate area, were nesting in the vicinity.

- Spotted sandpiper (*Actitis macularia*)
 - Ring-billed gull (*Larus delawarensis*)
 - Whip-poor-will (*Antrostomus vociferus*)
 - Kingfisher (*Megaceryle alcyon*)
 - Ruby-throated hummingbird (*Archilochus colubris*)
 - Flicker (*Colaptes auratus*)
 - *Yellow-bellied sapsucker (*Sphyrapicus varius*)
 - Crested flycatcher (*Myiarchus crinitus*)—abundant 1949, scarce 1950.
 - *Least flycatcher (*Empidonax minimus*)
 - Robin (*Turdus migratorius*)—abundant 1949, less so 1950.
 - Veery (*Hylocichla fuscescens*)
 - *Cedar waxwing (*Bombycilla cedrorum*)
 - **Red-eyed vireo (*Vireo olivaceus*)
 - Magnolia warbler (*Dendroica magnolia*)—1950 only; immature.
 - Myrtle warbler (*Dendroica coronata*)
 - Pine warbler (*Dendroica pinus*)—1949 only.
 - Oven-bird (*Seiurus aurocapillus*)
 - Purple finch (*Carpodacus purpureus*)
 - Goldfinch (*Spinus tristis*)
 - *Chipping sparrow (*Spizella passerina*)
 - Song sparrow (*Melospiza melodia*)
- One blue-tailed skink (*Eumeces fasciatus*) was collected from among the rocks at the lake-edge in this habitat.

Mammals: Since the area is relatively dry, there is a large chipmunk population in and around the rocks. Skunks are common, probably attracted by the garbage from the few cottages in the area. One half-grown and one very emaciated adult female were collected. Another young *Mephitis*, a litter mate of the one collected, was also known to be in the area, and possibly others were present. Red squirrels were at one time abundant, but have been completely "shot out." At least one mink is known to have been in the area. Porcupines have wandered in and out, but are shot on sight. One young racoon was found dead, apparently a highway casualty, as the animal was entire, including its pelt.

In 1949, eighteen traps were set in the area in places looking suitable for small mammals, such as rock crevices, along fallen logs, and at the

bases of rocks. These remained for three nights, during which time one *Peromyscus maniculatus gracilis*, three *Peromyscus leucopus noveboracensis*, and two *Blarina brevicauda talpoides* were captured, making nine trap-nights, per catch.

In 1950, no mouse traps were set, but five rat traps were placed in likely spots for chipmunks. None was caught, but one *Blarina* fell victim. Later the traps were moved and baited with bacon rind for flying squirrels. These traps caught one juvenile *Peromyscus maniculatus gracilis* the first night and two nights later took a half-grown *Mephitis*.

TRAPPING SUMMARY—1949

Date: July	3	4	5	Total
<i>Peromyscus m. gracilis</i>	0	0	1	1
<i>Peromyscus l. noveboracensis</i>	1	1	1	3
<i>Blarina b. talpoides</i>	1	1	0	2
Total	2	2	2	6

6 catches in 54 trap-nights, or 1/9 trap-nights.

Summary 1950: 50 trap-nights (rat traps)—3 catches or 1/17 trap-nights.

II. *A damp, second-growth, deciduous woods along Bon Echo Creek, five and one-half miles north of Cloyne, Ontario. Elevation 900 feet. Trapped in only in 1949.*

Bon Echo Creek flows from Bon Echo Lake to Mazinaw Lake, where it empties on the west shore. The gradient from Bon Echo to Mazinaw is slight, resulting in the creek being a slow-flowing stream traversing a poorly drained area with many bogs. The soil is rich, black, and acid, and the creek is stained dark from this acid bog soil through which it flows. The surrounding forest is composed primarily of second-growth deciduous trees with some firs, and patches of white and black spruces in the drier and wetter areas respectively. An occasional white pine still stands. Most of the growth has developed since the area was burned over about twenty years ago. A road passes through the area, and ends at an abandoned lumber camp at the east end of Bon Echo Lake. The undercover is very dense with a large percentage of alder, aspen, and white birch saplings.

A list of the dominant vegetation follows.

White pine (*Pinus strobus*)

White spruce (*Picea glauca*)

*Black spruce (*Picea mariana*)

*Balsam fir (*Abies balsamea*)

*Large-toothed aspen (*Populus grandidentata*)

*Trembling aspen (*Populus tremuloides*)

- Yellow birch (*Betula lutea*)
 *White birch (*Betula papyrifera*)
 *Speckled alder (*Alnus incana*)
 White elm (*Ulmus americana*)
 Moosewood (*Acer pennsylvanicum*)
 *Sugar maple (*Acer saccharum*)
 *Red maple (*Acer rubrum*)

Sensitive fern (*Onoclea sensibilis*)
 Thin-leaved pyrola (*Pyrola elliptica*)

This habitat is of a more southern type than any of the others trapped, and approaches the transition (upper austral) zone in character.

The birds noted in the area are:

- Ruffed grouse (*Bonasa umbellus*)—covey of 6 young.
 Woodcock (*Philohela minor*)
 Hummingbird (*Archilochus colubris*)
 Crested flycatcher (*Myiarchus crinitus*)
 Phoebe (*Sayornis phoebe*)
 Robins (*Turdus migratorius*)

Mammals: Deer tracks were seen along the old dirt road. Every time the area was visited a *Lepus americanus*, apparently the same one, was seen alongside the road in approximately the same spot. On every occasion I was able to approach within a few feet of this animal without unduly alarming it.

Forty-nine traps were set in the area with thirty-three through the moist woodland and along the stream in likely looking spots. An especially promising site for voles was a rocky portion of a grass-grown, abandoned road. Seven traps were set in a small, bog area with black spruce saplings and alders growing in a wet black soil, and nine in a dry patch of white spruces. These traps were left set for only two nights.

Two *Peromyscus maniculatus gracilis*, one *Peromyscus leucopus noveboracensis*, and four *Blarina* were caught in this area. One *Microtus pennsylvanicus* was caught in the grassy spot mentioned above, but was eaten, apparently by a shrew, and could not be saved as a specimen. A total of eight mammals caught meant 1 catch per 12.25 trap-nights.

TRAPPING SUMMARY—1949

Date: July	3	4	Total
<i>Peromyscus m. gracilis</i>	2	0	2
<i>Peromyscus l. noveboracensis</i>	1	0	1
<i>Blarina b. talpoides</i>	2	2	4
<i>Microtus p. pennsylvanicus</i>	1	0	1
Total	6	2	8

III. *A dense, cool, black ash-northern white cedar bog, five and one-half miles south of Denbigh, Ontario. Elevation 950 feet. Trapped in 1949 and 1950.*

A typical, dense, cool, northern white cedar-black ash bog, which has apparently been by-passed by recent-past fires or lumbering operations. The actual bog area is approximately fifty yards wide and extends north and south about a half-mile, draining into a small mill pond at the south. The bog is criss-crossed with fallen white cedar logs, subdividing the area into a series of small, disconnected "boglets." These vary from a few feet in each dimension up to about twenty by fifty feet. The black, acid, mucky soil supports a dense growth of sphagnum which continues on, with other mosses, over fallen logs, stumps, and hummocks. Liverworts and *Selaginella* were also included with the mosses. In 1949, there was no standing water in the bog except in the center of one very large boglet, where there were a few inches. The area remained wet, however, in spite of the lack of standing water. In 1950, there were between twelve and eighteen inches of water throughout the bog, and this was added to in the first week of July by the almost daily rains. The hills forming the east and west boundaries of the bog were covered chiefly with white and black spruces and firs. Black spruces and firs also occurred in the bog, but were not among the dominant forms. The full grown, standing, white cedars, and the great majority of the cedars were of this type, averaged a foot *d.b.h.*, while the fallen trunks of these trees were of this size or larger. The relatively uniform size of the standing cedars probably indicates the growth since some past lumbering operations or fires. The surrounding spruces were mature trees in the neighborhood of fifty or sixty feet tall.

The bog abutted abruptly against a low, fault scarp on the east. This scarp varied from a few to over thirty feet in height. Under the sphagnum-covered talus at its base was a continuous "tunnel-run" which produced the usual high catches of an "edge" habitat. This scarp appears to be a northward continuation of that forming the eastern shore of Mazinaw Lake, and is at the northern end of a continuous valley containing a series of bogs and small and large lakes. It is also the center of drainage for the immediately surrounding area.

A list of the major plant forms follows:

*White spruce (*Picea glauca*)—adjoining dry areas.

*Black spruce (*Picea mariana*)

*Balsam fir (*Abies balsamea*)

**Northern white cedar (*Thuja occidentalis*)

Trembling aspen (*Populus tremuloides*)
 White birch (*Betula papyrifera*)
 Speckled alder (*Alnus incana*)
 White elm (*Ulmus americana*)
 Moosewood (*Acer pennsylvanicum*)
 Black alder (*Ilex bronxensis*)
 Alder-leaved buckthorn (*Rhamnus alnifolia*)
 Red baneberry (*Actaea rubra*)—in berry 1949.
 White baneberry (*Actaea alba*)—in berry 1949.
 Squashberry (*Viburnum pauciflorum*)—in berry 1949.
 Labrador tea (*Ledum groenlandicum*)

**Various mosses and sphagnum.

Thallus liverworts

Bunchberry (*Cornus canadensis*)—in berry 1949; in bloom 1950.

*Small cranberry (*Vaccinium oxycoccos*)

*Wood sorrel (*Oxalis montana*)—in bloom 1950.

*Barren strawberry (*Waldsteinia fragaroides*)—in bloom 1950.

Arctic bramble (*Rubus borealis*)—in bloom and berry 1950.

Yellow bead lily (*Clintonia borealis*)—in bloom 1950.

Wild sarsaparilla (*Aralia nudicaulis*)—in berry 1949; just past bloom 1950.

Cinnamon fern (*Osmunda cinnamomea*)

Shining club moss (*Lycopodium lucidulum* v. *occidentale*)

Running club moss (*Lycopodium clavatum*)—adjoining dry areas.

Round-branch ground pine (*Lycopodium obscurum* v. *dendroideum*)—dry areas.

From the comments in this list it again becomes evident how much later the 1950 season was than the same period in 1949.

The birds noted in the area follow:

Horned grebe (*Colymbus auritus*)

Broad-winged hawk (*Buteo platypterus*)

Flicker (*Colaptes auratus*)

Pileated woodpecker (*Ceophloeus pileatus*)—only in 1949; one seen.

Yellow-bellied sapsucker (*Sphyrapicus varius*)

Hairy woodpecker (*Dryobates villosus*)

Downy woodpecker (*Dryobates pubescens*)

Least flycatcher (*Empidonax minimus*)

Eastern wood pewee (*Myiochanes virens*)

Bluejay (*Cyanocitta cristata*)

Black-capped chickadee (*Penthestes atricapillus*)
Tufted titmouse (*Bacolophus bicolor*)—1949 only.
White-breasted nuthatch (*Sitta carolinensis*)—1949 only.
Red-breasted nuthatch (*Sitta canadensis*)
Brown creeper (*Certhia familiaris*)
Blue-headed vireo (*Vireo solitarius*)
Black and white warbler (*Mniotilta varia*)
Ovenbird (*Seiurus aurocapillus*)
Canada warblers (*Wilsonia canadensis*)
Bronzed grackles (*Quiscalus quiscula*)
Rose-breasted grosbeak (*Hedymeles ludovicianus*)
Junco (*Junco hyemalis*)

The drought conditions prevailing during 1949 may account for the birds (especially the titmice) observed in this area in that year, which were not seen in 1950. In 1950, however, the breeding bird population was noticeably higher than in the previous year; for example, there were at least two pairs of rose-breasted grosbeaks in 1950 in this relatively small, trapping area. The warblers were conspicuously abundant in the latter year.

Mammals: In 1949, *Tamiasciuris* and *Marmota* were seen in this habitat. The former were abundant, although efforts to trap them failed. The red-squirrels were conspicuous by their absence in 1950, nor were any *Marmota* seen. Chipmunks were abundant in the dry areas surrounding the bog in both years.

In 1949 the area was trapped for six nights. Traps were placed along fallen logs, at openings of runs in the centers of boglets, under overhanging hummocks, and in runs along the scarp base. The traps were concentrated and the area was trapped in two sub-areas at two separate times. In the first area, for the first night, there were eighty-seven traps which were reduced to fifty-three for the following two nights by removing one or more from each station. Sixty-six traps were used for the last three nights in a part of the bog north of the first area, making a total for the area of 391 trap-nights. The trapping summary appears below.

One *Condylura* and one *Synaptomys* were trapped at the fault base run. Four *Clethrionomys* were taken in and around the western edges of the bog where it adjoined the white spruce-fir covered hillside. *Blarina* was found on the dry hillside next to the bog, while the long-tailed shrews (*Soricidae*) were all taken in the boglets throughout the swamp. *Peromyscus leucopus novaboracensis* was taken mainly in drier areas, while the one *Peromyscus*

maniculatus gracilis was taken in the wet area. A total of sixteen mammals caught meant 1 catch per 24 trap-nights.

TRAPPING SUMMARY—1949

Date: July	5 (87)	6 (53)	7	11 (66)	12	13	Total
<i>Condylura c. cristata</i>	1	0	0	0	0	0	1
<i>Sorex c. cinereus</i>	0	0	1	1	0	0	2
<i>Sorex f. fumeus</i>	0	0	0	0	1	0	1
<i>Sorex p. albibarbus</i>	1	0	0	0	0	0	1
<i>Blarina b. talpoides</i>	0	0	1	0	1	0	2
<i>Peromyscus m. gracilis</i>	0	0	0	0	0	1	1
<i>Peromyscus l. noveboracensis</i>	1	0	0	0	1	0	3
<i>Synaptomys c. cooperi</i>	1	0	0	0	0	0	1
<i>Clethrionomys g. gapperi</i>	0	1	0	3	0	0	4
Total	4	1	2	5	3	1	16

In 1950 this area was re-trapped intensively for several reasons: (1) to compare the population with last year, (2) to obtain more shrews, and (3) because of the large number of species obtained in 1949 in such a limited area and habitat. Much the same trap concentration was used as in 1949, but a somewhat wider area was covered, with more traps. Due to the standing water this year, no traps were placed in the boglet bottoms, being necessarily placed in dry spots around the edges. Traps, 101 in number, were placed across the bog, along the cliff base, and back across the bog again for two nights. For the next three nights the same number of traps were in the bog, but sixty-one of them were removed from the original sets and re-set in other areas, with about half of these being along the scarp base. For the following three nights seventy-two of the scarp and last-set bog traps (in an area similar to the conditions of last year with no standing water) were left in place, the remaining twenty-nine in the bog center having been picked up, since no mammals were caught in that area. This constituted a total of 721 trap-nights under trap concentrations and movements similar to those of 1949.

No rodents were caught in this area in 1950, and no mammals were caught in the center of the bog in areas with or without standing water. One specimen of *Microsorex*, two of *Sorex cinereus*, and one of *Sorex fumeus* were caught in the scarp-base run. One *Blarina* was caught in a dry spot at the western edge. Four of these five mammals were caught the first two nights, and the fifth (*Sorex cinereus*) three nights later. This strongly suggests that the four represented the total small mammal population of the bog, and that the fifth was an outside wanderer that came in. It seems reasonable that the water level made the difference in the loca-

tion of the shrews within the habitat in the two years. In 1949, with a wet, black muck and no standing water, the shrews were scattered over the bog, but in 1950, with abundant water, no shrews were in the center of the bog, all having been taken at the bog's eastern margin in the scarp-base run. The total catch of five mammals was the equivalent of 1 catch per 144 trap-nights.

TRAPPING SUMMARY—1950

Date: July	3 (101)	4	5 (61) reset	6	7	8 (72)	9	10	Total
<i>Microsorex h. inter-</i>									
<i>vectus</i>	1	0	0	0	0	0	0	0	1
<i>Blarina b. talpoides</i>	1	0	0	0	0	0	0	0	1
<i>Sorex c. cinereus</i>	0	1	0	0	1	0	0	0	2
<i>Sorex f. fumeus</i>	0	1	0	0	0	0	0	0	1
Totals	2	2	0	0	1	0	0	0	5

IV. A dry, old field, seven miles south of Denbigh, Ontario. Elevation 1,000 feet. Trapped in only in 1949.

A dry, grassy, old field with many rocks and piles of old fence-rails surrounding a field of un-mown rye. A stone fence topped by a broken-down rail fence separates the two fields. *Polytrichum*, dry grasses (*Danthonia*), sweet fern (*Myrica asplenifolia*), and bracken (*Pteridium latiusculum*) were the dominant plants. An extensive, pure stand of white spruce surrounds the area. A pair of ravens were once seen in this area, as well as purple finches, and song and vesper sparrows.

Mammals: Hares (*Lepus americanus*) were frequently seen along the highway in this area, and deer (*Odocoileus*) were seen just south of the area. The rye field probably was attractive to many mammals.

Only six traps were placed in the area, for three nights. These were placed along the old stone and rail fence. Three specimens of *Peromyscus leucopus noveboracensis*, one *Microtus pennsylvanicus*, and one *Tamias striatus lysteri* were caught. One of the *Peromyscus* was captured, by the front foot only, and it remains alive and well at the present writing. This was the most productive area trapped relative to trap-nights per catch, with 1 catch per 3.6 trap-nights.

TRAPPING SUMMARY—1949

Date: July	5	6	7	Totals
<i>Peromyscus l. noveboracensis</i>	3	0	0	3
<i>Microtus p. pennsylvanicus</i>	0	1	0	1
<i>Tamias s. lysteri</i>	0	1	0	1
Totals	3	2	0	5

V. An open, sphagnum-*Vaccinium* bog, five miles south of Cloyne. Elevation 850 feet. Trapped in only in 1949.

This area was once a black spruce-tamarack bog but, having been cleared for a high-power line, it is now primarily an open bog with a dense mat of sphagnum supporting a heavy growth of *Vaccinium* and *Kalmia*. There are a few black spruce and tamarack seedlings in the cleared area. On either side of the clearing are stands of mature black spruces and tamaracks, while on the drier surrounding land are white spruces and firs. In 1949 this was thoroughly dried out and few spots of standing water remained; one in particular was formed by a stone and log cradle for a power-line pole. Ordinarily the entire area would be quite wet. The principal vegetation follows:

**Sphagnum

- *Pale laurel (*Kalmia polifolia*)
- *Sheep laurel (*Kalmia augustifolia*)
- *Bog bilberry (*Vaccinium uliginosum*)
- *Small cranberry (*Vaccinium oxycoccos*)
- *Canada blueberry (*Vaccinium canadense*)

Cattails (*Typha* sp.)

Tamarack (*Larix laricina*)

Black spruce (*Picea mariana*)

Pitcher plant (*Sarracenia purpurea*)

The birds noted, principally in the black spruce-tamarack, mature stand, follow:

- Kingbird (*Tyrannus tyrannus*)
- Wood pewee (*Myiochanes vireus*)
- Barn swallow (*Hirundo erythrogaster*)
- Bluebird (*Sialia sialis*)
- Bronzed grackles (*Quiscalus quiscula*)
- Myrtle warbler (*Dendroica coronata*)
- Vesper sparrow (*Poocetes gramineus*)

This type of habitat is common in low areas south of Cloyne and north of the lake-plain region.

Mammals: In the dried-out portion of the sphagnum bog, there were abundant old runs containing old, dried (winter or early spring) *Synaptomys* droppings and cuttings. The spruce edge sphagnum floor had similar runs with black droppings. *Lepus* runs (and forms) were abundant, criss-crossing the area, and one hare was jumped from its form in the vicinity of the cradle every time the area was visited. The wet areas con-

tained numerous runs in the sphagnum containing bright green, vole feces and fresh cuttings of grasses and mosses (*Polytrichum*). Apparently these voles had migrated to the wetter spots as the bog dried.

Fifty-three traps were set across the area so that the spruce edge, a few of the dry spots, and a large portion of the wetter areas with fresh signs, were trapped. The traps averaged about ten feet distant from each other. *Synaptomys*, and possibly *Zapus* and *Sorex*, were considered likely catches. The traps remained set out for two nights.

Two specimens of *Synaptomys cooperi cooperi* and one *Peromyscus leucopus noveboracensis* were caught the first night, comprising the entire catch, or 1 catch per 35 trap-nights.

TRAPPING SUMMARY—1949

Date: July	6	7	Totals
<i>Peromyscus l. noveboracensis</i>	1	0	1
<i>Synaptomys c. cooperi</i>	2	0	2
Totals	3	0	3

VI. *A small creek and a high, alder bog in the dry hills, seven miles north of Cloyne, Ontario. Elevation 1,050 feet. Trapped in part in 1949, further in 1950.*

This area includes more than the specific area trapped, and consists really of more than one type of habitat. The hill on either side of the area trapped is included in the following discussion. The hillside itself is a dry, deciduous, second growth woods with a few remaining white and red pines and some white spruces. White pines, however, comprise the great majority of the seedlings in the area, almost to the exclusion of all other types. Large-toothed and trembling aspens, white birch, and sugar maple are the dominant mature trees. The middle of the hill is traversed by a small rock-lined stream with a black mud bottom. This stream successively drains an alder marsh, a cattail-sedge marsh, another alder bog, and alternating bogs of these two types above this. These extensive bog areas lie in a flat, shallow valley between the hills. An abandoned road crosses the stream about half-way up the hill, and below the road the stream becomes much rockier and flows more rapidly. Sugar maples and herbaceous plants are much heavier along the stream than on the rest of the hill.

The plants in the general area include:

White pine (*Pinus strobus*)

Red pine (*Pinus resinosa*)

- White spruce (*Picea glauca*)
 Black spruce (*Picea mariana*)
 Balsam fir (*Abies balsamea*)
 Hemlock (*Tsuga canadensis*)
 *Trembling aspen (*Populus tremuloides*)
 *Large-toothed aspen (*Populus grandidentata*)
 *Speckled alder (*Alnus incana*)
 Black willow (*Salix nigra*)
 Basswood (*Tilia americana*)
 Red osier dogwood (*Cornus stolonifera*)
 Beaked hazelnut (*Corlylus rostrata*)
 Long-beaked willow (*Salix rostrata*)
 *Sugar maple (*Acer saccharum*)
 Red maple (*Acer rubrum*)
 Moosewood (*Acer pennsylvanicum*)
 Red oak (*Quercus borealis*)
 Sycamore (*Plantanus occidentalis*)
 Black cherry (*Prunus serotina*)
 Smooth-leaved shadbush (*Amelanchier laevis*)
 Bush honeysuckle (*Diervilla lonicera*)
 White ash (*Fraxinus americana*)
 Toothed woodfern (*Dryopteris spinulosa*)
 Cinnamon fern (*Osmunda cinnamomea*)
 Interrupted fern (*Osmunda claytonia*)
 Sensitive fern (*Onoclea sensibilis*)
 *Sphagnum—in the bogs.
 Yellow bead lily (*Clintonia borealis*)
 *Wool grass (*Scirpus cyperinus*)—bogs.

The birds in this area were observed rather closely, and those on the following list are all breeding birds, noted in both 1949 and 1950. At the time of the observations of 1950, fledglings and young of all varieties were abundant. The second growth, the slashings, the bare grassy areas, the low brush, and the variety of habitats apparently provided ideal breeding locations for most varieties, especially the brush-loving warblers. This area had a higher bird population than any other habitat discussed in regard to both species and individuals.

- Ruffed grouse (*Bonasa umbellus*) Female and covey of young.
 Woodcock (*Philohela minor*)
 Whip-poor-will (*Antrostomus vociferus*)

Hummingbird (*Archilochus colubris*)—feeding on sap of white-birch from sapsucker holes.

Northern flicker (*Colaptes auratus*)

Yellow-bellied sapsucker (*Sphyrapicus varius*)

Least flycatcher (*Empidonax minimus*)

Wood pewee (*Myiochanes virens*)

Bluejays (*Cyanocitta cristata*)

Black-capped chickadee (*Penthestes atricapillus*)

Winter wren (*Nannus hiemalis*)

Robins (*Turdus migratorius*)—abundant 1949, scarcer 1950.

Hermit thrush (*Hylocichla guttata*)

Veery (*Hylocichla fuscescens*)

Cedar waxwing (*Bombycilla cedrorum*)

Red-eyed vireo (*Vireo olivaceus*)

Black-throated blue warbler (*Dendroica coerulescens*)

Black-throated green warbler (*Dendroica virens*)

Chestnut-sided warbler (*Dendroica pensylvanica*)

Ovenbird (*Seiurus aurocapillus*)

Redstart (*Setophaga ruticilla*)

Magnolia warbler (*Dendroica magnolia*)

Nashville warbler (*Vermivora ruficapilla*)

Rose-breasted grosbeak (*Hedymeles ludovicianus*)

Indigo buntings (*Passerina cyanea*)

Purple finch (*Carpodacus purpureus*)

Goldfinch (*Spinus tristis*)

Chipping sparrow (*Spizella passerina*)

Mammals: Bears (*Euarctos americanus*) have been shot frequently in this area, and a barren field on the hill crest contained numerous overturned stones where a bear had been looking for ants. Tracks of minks, racoons, deer, and foxes were seen in a muddy rut between two parts of an alder bog. The abandoned road in this area apparently provided a well-travelled animal highway. A skunk was seen walking up this road in mid-afternoon.

In 1949, fifty-five traps were set; sixteen along the creek and through an alder bog, eight through a sedge meadow in underground muddy runs, twenty-two in a dense, alder and deciduous thicket, and nine in a cattail-sedge marsh. These traps were set for two nights and yielded one *Sorex fumeus*, one *Blarina b. talpoides*, one *Peromyscus maniculatus gracilis*, and six examples of *Microtus pennsylvanicus*. The latter were

caught in both the sedge meadow and the dense, alder bog. The average catch was 1 per 12.2 trap-nights.

TRAPPING SUMMARY—1949

Date: July	9	10	Totals
<i>Sorex f. fumeus</i>	0	1	1
<i>Blarina b. talpoides</i>	1	0	1
<i>Peromyscus m. gracilis</i>	1	0	1
<i>Microtus p. pennsylvanicus</i>	5	1	6
Totals	7	2	9

In 1950 twenty-nine traps were set along the same stream starting just across the abandoned road from the beginning of the line of 1949 and working downstream for about two-hundred feet. This portion of the stream had steep banks and was rockier than above. There were numerous, large boulders with many runs, crevices, and other likely places for small mammals. These traps were set for three nights and produced one *Sorex fumeus*, one *Condylura cristata*, and two of *Blarina brevicauda talpoides*, for an average of 1 catch per 22 trap-nights.

TRAPPING SUMMARY—1950

Date: July	8	9	10	Totals
<i>Condylura c. cristata</i>	1	0	0	1
<i>Sorex f. fumeus</i>	0	0	1	1
<i>Blarina b. talpoides</i>	1	0	1	2
Totals	2	0	2	4

VII. A small, sphagnum bog in a patch of spruces, 0.6 miles west of route 41 and 1.25 miles southeast of Massanoga, Ontario. Elevation 950 feet. Trapped in in 1949 only.

This is a small sphagnum bog in a patch of black spruce and firs in the center of a larger and more extensive forest of second-growth hardwoods. In many respects it is much like trapline III except that it is not as extensive or dense, and in general is an area not as cool. It was at one time burned over, as many charred stumps and logs cover the ground. The bog is divided into boglets by fallen logs, and these are covered with mosses, primarily sphagnum. Standing water persisted in some of the boglets in 1949. The outstanding feature of this habitat is its present discontinuity with the surrounding drier forest, and it is consequently an island situation.

The principal vegetation is as follows:

*Black spruce (*Picea mariana*)

Balsam fir (*Abies balsamea*)

- *Black ash (*Fraxinus nigra*)
- Red baneberry (*Actaea rubra*)
- *Sphagnum, and other mosses and liverworts.
- *Yellow bead lily (*Clintonia borealis*)
- Star violet (*Dalibarda repens*)

Mammals: Twenty-one traps were set in this area in locations very similar to those in trapline III: in suitable runs, along fallen logs, around stump bases, and other such spots. One *Condylura cristata* and one *Microtus pennsylvanicus* were taken in two nights of trapping. This seemed like an ideal spot for *Clethrionomys* and for *Sorex*, but since none were caught, the conclusion was reached that the area was too small to support a typical bog or bog-edge fauna in an extensive dry habitat. There was one catch for each 21 trap-nights.

TRAPPING SUMMARY—1949

Date: July	10	11	Totals
<i>Condylura c. cristata</i>	0	1	1
<i>Microtus p. pennsylvanicus</i>	0	1	1
Totals	0	2	2

VIII. *A sedge meadow and a marsh area in an old lake fill, 1.2 miles southeast of Massanoga and 1.2 miles west of route 41, on the old road to Mica. Elevation 950 feet. Trapped in only in 1949.*

This is a completely open "beaver meadow" of grasses and sedges (wool grass, locally called "beaver hay"), about three-quarters of a mile long and varying from one-quarter to one-half mile wide. A small lake still remains unfilled at the western end of the area. A small, muddy, slow-flowing creek traverses the center of the area after leaving the lake. The stream is dark and very acid, as are all of the streams in this area. The wool grass is about three feet tall and forms a dense cover under which is a thick blanket of sphagnum, broken dead sedges, and other litter. Surrounding the meadow is a dense zone of speckled alders which, along with small willows, are now reaching out into the meadow area, and are thinly scattered throughout, as well as lining the central creek. These alder thickets seem to be a favorite breeding place for chestnut-sided warblers. Surrounding the alders, and on slightly higher ground, are tamaracks, white spruces, black spruces, white pines, and beyond these are mixed hardwoods in which the white birch is dominant. The vegetation of the area is listed below:

White spruce (*Picea glauca*)—edges.

Black spruce (*Picea mariana*)—edges.

Tamaracks (*Larix laricina*)—edges.

White pine (*Pinus strobus*)—edges.

*Speckled alder (*Alnus incana*)

*Black willow (*Salix nigra*)

White birch (*Betula papyrifera*)—edges.

**Sphagnum.

**Wool grass (*Scirpus cyperinus*)—"Beaver hay."

Cattails (*Typha* sp.)

Chestnut-sided warblers (*Dendroica pennsylvanica*) were breeding in large numbers in the low willow and alder bushes in the area, especially along the northern margin, where there was an extensive area of second-growth white birch and large alders and willows.

Mammals: Beavers were at one time plentiful in the lake at the west end of the meadow, but are now reduced by trapping to just a few. According to the report of the trapper for this area (Albert Spencer, Cloyne), they are building up again (1950) as a result of the present Ontario trapping laws. *Tamiasciurus* was plentiful in 1949, see the account under the species discussion.

Twenty-eight traps were put out at twenty-one stations about twelve feet from each other, extending in a straight line across the meadow with a few scattered on the opposite side in a patch of spruces and alders. Two of *Blarina b. talpoides*, one *Peromyscus maniculatus gracilis*, one *Peromyscus l. noveboracensis*, and one *Microtus pennsylvanicus* were caught in two nights of trapping, or 1 catch per 11.2 trap-nights.

TRAPPING SUMMARY—1949

Date: July	10	11	Totals
<i>Blarina b. talpoides</i>	1	1	2
<i>Peromyscus m. gracilis</i>	0	1	1
<i>Peromyscus l. noveboracensis</i>	1	0	1
<i>Microtus p. pennsylvanicus</i>	1	0	1
Totals	3	2	5

IX. A high, dry, barren rocky hill, 8.5 miles south of Denbigh, Ontario. Elevation 1,000 to 1,150 feet. Trapped in only in 1950.

This area represents one of the habitat types missed in 1949. The hill is a solid eminence of quartzite, and is one of the typical glaciated granitoid hills of the region. It is very steep-sided to the east, north, and south, but slopes more gradually to the west. At one time this now barren

hill may have been forested, as a few burned logs bear mute evidence to a previous fire. At present, however, large areas of bare rock lie exposed, especially where the slope is steep. A few aspens have gained a foothold along with patches of poverty grass, blueberries, brackens, and a sweet fern. A few other plants are found in the area, as the following list shows. The dominant form, however, is the blueberry, and this site is more or less typical of the many so-called blueberry balds or barrens in this region. Many of the hilltops and higher elevations are of this type of habitat. The soil, where it has been gathered in the more level spots, is a breakdown of the altered sandstones which form the hill itself. It is in these relatively level areas, in cracks, and in such soil-gathering spots that the plant life is found. The area is very dry and exposed. Blueberries were ripe at the time of trapping (July 4, 5, and 6), in contrast to the other areas in this region.

The following plants were noted.

*Lichens.

*Bracken (*Pteridium latiusculum*)

*Hair moss (*Polytrichum* sp.)

White pine (*Pinus strobus*)—very few.

White spruce (*Picea glauca*)—very few.

Trembling aspen (*Populus tremuloides*)

Large-toothed aspen (*Populus grandidentata*)

White birch (*Betula papyrifera*)

*Sweet fern (*Myrica asplenifolia*)

*Poverty grass (*Danthonia* sp.)

Smooth sumac (*Rhus glabra*)

**Low sweet blueberry (*Vaccinium pennsylvanicum* v. *angustifolium*)

Ground bean (*Strophostyles helvola*)

Pink fume root (*Corydalis sempervirens*)

Hairy rock cress (*Arabis hirsuta*)

Whorled loosestrife (*Lysimachia quadrifolia*)

Barren strawberry (*Waldsteinia fragaroides*)

Not many birds were noted in the area. Those seen follow:

Bluejays (*Cyanocitta cristata*)

Black-throated green warbler (*Dendroica virens*)

Ovenbird (*Seiurus aurocapillus*)

White-throated sparrow (*Zonotricha albicollis*)

Mammals: This area was picked as typical of the high blueberry barrens of the region, in the belief that the faunal inhabitants would be

representative of this type of habitat. Some runways, old signs, and grass cuttings were found around the grasses and blueberries. The cuttings and runs were old. One *Tamias* was seen feeding on blueberries, otherwise no mammals were seen.

Forty-seven traps were put out, starting in a blueberry patch at the base of a steep, rock face about 150 feet below the summit, and extending on up to the crest with traps placed in all suitable patches of blueberries, grasses, or brackens, and along the bases of cliffs, and around the few logs and stumps. A few were put in relatively barren spots. The average trap interval was ten feet. The traps were baited with a mixture of peanut butter, ham-fat, and almond extract, and oatmeal was scattered over each trap. No small mammals were trapped in the three nights the traps were left set, although a few were sprung by a heavy rain during the first night.

It seems probable that this type of habitat is marginal in this region and that during a year of excessively low population, as in 1950, it remains practically uninhabited. The evidence of runs, signs, and cuttings shows the area to have been occupied by small mammals in the past, probably the preceding fall and early winter.

X. *A dense, black spruce bog, 4.5 miles south of Denbigh, Ontario. Elevation approximately 1,000 feet. Trapped in in 1950 only.*

In 1949, no traps were placed in the climax black spruce bog, so this area was trapped in during 1950 to fill this gap. This is a typical, boreal, black spruce bog. The upper story was almost a pure stand of mature black spruce with a few tamaracks. The understory was a solid carpet of sphagnum with Labrador tea growing from it. The spruce habitat was extensive, and has apparently been totally by-passed by fire and timbering except for a small area at the south end which now consists of an overstory of speckled alder. Water was standing beneath the sphagnum. The soil is acid, black muck. Small cranberries are common. The alder portion had less sphagnum with more of the black muck being exposed. Also, there was little standing water in this portion of the bog.

The higher ground surrounding the bog was covered almost entirely with white spruce and fir. Cinnamon ferns and yellow bead-lillies formed a dense cover around the periphery of the bog.

Floral list of the area:

**Black spruce (*Picea mariana*)

*Tamarack (*Larix laricina*)

*Speckled alder (*Alnus incana*)

**Sphagnum.

**Labrador tea (*Ledum groenlandicum*)

*Small cranberry (*Vaccinium oxycoccos*)

Heart-leaf lily (*Maianthemum canadense*)

Bunchberry (*Cornus canadensis*)

*Deer vine (*Linnaea americana*)—in bloom.

Barren strawberry (*Waldsteinia fragaroides*)

Arctic bramble (*Rubus arcticus*)—in berry.

The following birds were noted in the area, although no concentrated effort was made to obtain a complete list due to the density of the growth with its attendant poor visibility. All are probably nesters in or near the area.

Pair of Broad-winged hawks (*Buteo platypterus*)

Ruffed grouse (*Bonasa umbellus*)

Red-breasted nuthatch (*Sitta canadensis*)

Nashville warbler (*Vermivora ruficapilla*)

Redstart (*Setophaga ruticilla*)

Purple finch (*Carpodacus purpureus*)

Mammals: The area was laced with runs of the snowshoe hare and fresh scats were abundant, although no hares were seen.

Forty-seven traps were set in the area at intervals of approximately twenty feet. The first fifteen traps were in the alder portion of the bog, and the remaining thirty-two were in the stand of black spruce. All traps were set in likely-looking spots with the spacing a secondary consideration; so that some were grouped more closely than others. These traps remained set and unmoved for four nights for a total of 188 trap-nights.

One *Sorex cinereus* was caught on the second night in the alder portion of the bog. One *Sorex cinereus* and one juvenile *Peromyscus maniculatus gracilis* were caught in the spruce portion of the bog on the fourth night. Two very hot, dry days preceded the final night, making one wonder if the two catches on that night hadn't wandered into the cool, moist, bog area from surrounding drier territory. The lack of catches in this portion of the bog for the three preceding nights tends to support the idea that these animals were transients from outside of the area. Three catches in 188 trap-nights equals 1 catch per 63 trap-nights.

TRAPPING SUMMARY—1950

Date: July	7	8	9	10	Totals
<i>Sorex c. cinereus</i>	0	1	0	1	2
<i>Peromyscus m. gracilis</i>	0	0	0	1	1
Totals	0	1	0	2	3

In addition to the specific trapping areas described above, highway 41 was a collecting locality. In 1949, three *Tamias*, one *Tamiasciurus*, and one *Lepus* were picked up and saved as specimens. In 1950 two *Tamias* were found in a condition good enough for specimens. Others were picked up which could not be saved. Among the latter were a weasel (*M. frenata*), several porcupines, several red squirrels in 1949 and another red squirrel in 1950. Many sight records were obtained along the highway for *Marmota*, *Mephitis*, *Mustela vison*, *Erethizon*, *Lepus*, *Odocoileus*, *Tamias*, and others, as well as for many of the birds. Most of the animals seen or picked up from the highway came from the hardwoods and brush along the roadside. *Lepus* and deer were seen especially about six miles south of Denbigh in a small grove of spruces below the farm of trap-site IV. In 1950 minks were twice seen crossing the highway in daytime. Road construction on portions of the highway reduced the number of animals seen in 1950 from that which otherwise might have been present. Hares were conspicuous by their absence from the road in 1950, only one record having been obtained, but that this was a result of the road-work was shown by their abundance along other roads. The discontinuance of road treatment with calcium chloride further reduced the numbers seen in 1950, since this salt attracted many mammals, especially hares, even though it resulted in their death from calcium poisoning.

III. ACCOUNTS BY SPECIES

***Condylura cristata cristata*.** This was the only mole captured in the area. Three specimens were captured, two in 1949 and one in 1950, in wet, muddy habitats. One was taken in the tunnel-run at the base of the scarp in area III, one along a fallen log in the area VII bog, and one at a run opening at the base of a rock wall in area VI (1950). It may be noted that all three of these moles were taken in runs at the bases of natural barriers.

A female captured on July 5, 1949 contained one extremely small embryo in each horn of the uterus, corresponding to a six day pregnancy (early implantation) in the rat. The female trapped on July 8, 1950 was not lactating, was not pregnant, and no implantation scars were found. A male trapped July 11, 1949 was immature with small abdominal testes. No smear of the testis was made. These data suggest that these moles may have two litters a year in this region.

***Sorex cinereus cinereus*.** Six of these shrews were captured, two in 1949 and four in 1950. The two specimens taken in 1949 and the two in

1950 were trapped in the black ash-white cedar bog (III). The bog had no standing water in 1949, and the shrews were caught in boglets in the center of the bog—one at a hole emerging from the black muck bottom, and the other at the base of an overhanging hummock. In 1950, when the boglets were under water, these shrews were caught in a tunnel-run at the base of a scarp at the bog edge, while none were caught in the central area. The remaining two specimens of *Sorex cinereus*, taken in 1950, were trapped in the black spruce-sphagnum bog (X): one in the black spruce portion, and the other in the alder portion of the bog. Both were in clumps of sphagnum.

Sorex cinereus in this region has the tricolor pattern with a distinct lateral band, described by Jackson (1928) as occasionally occurring. This pattern was much more conspicuous in dead specimens than in prepared skins. Another feature quite striking in specimens "in the flesh" is the much denser, softer, and silkier pelage found on *cinereus* than on *fumeus* when caught in the same place at the same time. The coarser pelage of *fumeus* is less pronounced in the dried skins, but it is nevertheless evident. This suggests that *cinereus* may have more fossorial habits than *fumeus*. All of the *cinereus* caught in both years had long tail pencils regardless of obvious age differences.

Both of the *cinereus* trapped in 1949 were pregnant females, one with six 9 mm. embryos caught on July 11, and the other with four minute embryos captured July 7. The distribution of the embryos in the uterine horns was equal in both shrews. One immature, non-pregnant female was caught in 1950. No implantation scars were found, the uterus was very small and juvenile, and the mammæ were obviously small and undeveloped. The three males of 1950 were all adult with scrotal testes and abundant sperm in the epididymes. The testicular smears, however, showed advanced degenerative changes, with few or no spermatozoa, chromolytic changes in the nuclei of the spermatids, and numerous giant cells containing up to twenty spermatid or secondary spermatocyte nuclei. Occasionally primary spermatocytes were found involved. The fact that all three males showed these changes is strong evidence that the adult males cease their reproductive activity at this time of the year.

If combining two years' findings is a valid procedure, the capture of a sexually immature female and two pregnant females at the same time of the year indicates that two litters may be raised. The fact that pregnant females were caught so late in the season is suggestive of this without any further evidence, as the young of the year probably have not reached

maturity by this time. The possibility still remains until disproven. The degenerative condition of the testes of the male shrews taken in 1950 indicates that the end of the spring breeding season occurs about the first of July.

With the adult males undergoing testicular degeneration in early July, the problem arises of determining the ages of shrews caught later in the summer. It has been noted in *Blarina* that the degenerate, late fall testes of adults have a flaccidity which is quite distinct from the small, firm testes of juvenile animals, and this may be a useful criterion for *Sorex cinereus*. Tooth-wear should also be a distinct aid at this point.

The evidence at hand, then, suggests that *Sorex cinereus* has a limited breeding season in the spring and early summer and that either (1), two or more litters may be raised per adult female, or (2), the young of the year reach maturity soon enough to become pregnant before the adult males undergo testicular regression early in July.

***Sorex fumeus fumeus*.** Four smoky shrews were captured: two in 1949, and two in 1950. One was caught each year in habitats III and VI. In 1949 one was caught beneath some alder roots along the streams of VI, while in 1950 another was caught farther down along the rocky bank of the same stream. The specimen taken in 1949 in the black ash-white cedar bog was caught at the base of a boglet hummock in the center of the area, while in 1950 this shrew was caught in the tunnel-run at the fault base. None was caught in the boreal, black spruce bog. The implication is that *Sorex fumeus* is more closely associated with deciduous growth than *cinereus* is in this region.

Of the four specimens of *Sorex fumeus*, three were females, one with an undetermined reproductive status, but not pregnant, and the other two obviously immature shrews with small, undeveloped uteri with no implantation scars. The one male, captured in 1950, was also immature with abdominal testes containing mainly spermatogonia with a very few primary spermatocytes. The interstitial cells were small. In contrast to *Sorex cinereus*, it appears from the collected evidence that *Sorex fumeus* in this region may have an early spring breeding season with probably only one litter raised. This is admittedly limited evidence, and Hamilton (1943) states that these shrews have two spring litters, and less often a third litter in the fall. The possibility of the young of the year being responsible for these later litters, however, is not precluded. It does seem, if there were adult, reproductively active individuals of *fumeus* about during the 1949

and 1950 trapping periods, that at least one would have been captured. Also, *Sorex fumeus* may have but one litter in the spring in this region, whereas it has two farther south and at a lower altitude. That the relative population levels of these animals may reflect changes in reproductive potentials must also be taken into consideration.

***Sorex palustris albibarbis*.** One male water shrew was captured in 1949 in the black ash-white cedar bog (III). Judging from its cross-wise and attenuated position in the trap, the animal apparently had been running along the mud at the base of an overhanging sphagnum hummock in the center of the bog. The habitats and trap locations were almost identical with those in which one of these shrews was caught in Monroe Co., Pa., in May 1949.

This animal was an immature male with abdominal testes measuring 1.0 x 1.5 mm. The testicular smear showed abundant spermatogonia, very few primary spermatocytes, and no spermatogenesis beyond this stage. There were no sperm in the epididymis.

None of these shrews was caught in 1950, when most of the bog was covered with standing water, even though the area was trapped much more heavily and for a longer period.

***Microsorex hoyi intervectus*.** One pregnant female was caught in the run at the base of the fault-face of the black ash-white cedar bog (III) on July 3, 1950. She had three very small embryos, two in the right and one in the left uterine horns. The mammæ were enlarged.

This shrew was captured in the same tunnel-run in which *Sorex cinereus* and *Sorex fumeus* were taken in 1950, and *Condylura* and *Synaptomys* in 1949, as well as the same bog in which these two shrews and *Sorex palustris* were taken in 1949. Thus four species of long-tailed shrews and *Blarina* were inhabiting the same bog. The obvious aquatic adaptations of *Sorex palustris* probably serve equally as well on the wet, black muck of the "1949 bog floor." That *Sorex cinereus* may lead a more fossorial existence than *Sorex fumeus* with slightly different habitat preferences has already been suggested, but where *Microsorex* fits in the ecological picture with these other shrews is difficult to say. That *Sorex palustris albiborbis* and *Microsorex hoyi intervectus* are much less common than the other two shrews is evident.

The thymus in all of these shrews was found to be extremely large, compared with most other mammals. It is a flat, leaf-like organ spreading over the entire ventral surface of the thorax, from its apex in the superior

mediastinum. The interscapular, hibernating gland mass, is likewise large and extends as a continuous mass over the back in the scapular region, passing posteriorly around the shoulder and into the axilla. In other mammals the hibernating gland exists as more or less discreet masses in these various regions.

Blarina brevicauda talpoides. Twelve short-tailed shrews were captured in 1949, and five in 1950. As elsewhere in their range, these shrews are probably the commonest mammals in the region. In 1949 they were caught in all habitats except the dry, old field (IV), the vaccinium-sphagnum bog (V), and the small, relatively warm, spruce bog, while in 1950 they were not caught on the high, dry bald (IX), or in the black spruce bog (X). The inference is that they do not occur in extensive, wet sphagnum bogs or excessively dry spots, but are otherwise ubiquitous. However, the low population of 1950 must be kept in mind. In years of peak populations they may possibly occur in these places.

Testicular smears were made of five males in 1949. Three of these showed all stages of spermatogenesis in the testes, and spermatozoa in the epididymes. All three had early degenerative changes with numerous, large giant cells of spermatids and secondary spermatocytes, chromolytic changes of the spermatid nuclei, and vacuolar degenerative changes of the spermatogonial series. The other two were immature with no spermatogenesis beyond a few primary spermatocytes and no sperm in the epididymes. Of the four males in 1950, two were immature with smear pictures similar to the above juvenile shrews. Two were adult with scrotal testes, sperm in the epididymes, and active spermatogenesis. One of these, however, showed marked degenerative changes of the testes, involving particularly the secondary spermatocytes and spermatids. Giant cells, composed primarily of spermatids, were abundant with up to ten nuclei. Most mature *Blarina*, then, probably undergo testicular regression at the end of the spring breeding season in this region, while a few may remain in a functional reproductive state, although they, too, may undergo degeneration at a later date than is covered in this account.

Four females were examined in 1949. None was pregnant; one had visible placental scars and was lactating, two others were lactating, and the fourth was obviously immature. The one "1950 female" was a nulliparous juvenile with remarkably prominent lateral scent glands. Since no pregnant females were trapped, it is probable that the peak of the breeding season had been passed by the first part of July.

Chiroptera. No bats were seen in the 1949 period, and sight records reported by various people all turned out to be chimney swifts. Definite knowledge of a few was obtained in the report of some which had been hanging behind the shutters of a lakeside cottage earlier in the summer.

In 1950, one was seen flying with a cicada in its mouth. It was flying across a clearing above Marble lake at dusk and the species could not be determined, but it appeared small—not much larger than the cicada. No others were seen.

Euarctos americanus. The black bear is common in the region. At this time of the year they are reported to be back in the bush feeding on blueberries. In 1950, many large stones turned over by a bear searching for ants were found in a barren field above area VI. The bear had apparently left shortly before my arrival, as the ants were still running around carrying their eggs to safety. There were others on the east shore of Mazinaw Lake during the 1949 period. In the early fall of 1947 three were trapped above the west shore of Mazinaw in area VI. The unanimous local opinion is that they are a nuisance.

Procyon lotor. Local trappers and residents report that raccoons are very abundant, but the present low value of their fur keeps them from being trapped. One dead juvenile, apparently a highway casualty, was picked up in area I on the west shore of Mazinaw Lake.

Martes americana. Two trappers (Al Spencer and Irving Brown) and the Lands and Forests District warden, all report that martens have been unknown in the region during their lives—about forty years. Martens were undoubtedly present at one time, but their trap stupidity has probably long since exterminated them throughout the district.

Martes pennanti. Reports on the fisher are conflicting, but it seems likely that some still exist about seven miles northwest of Mazinaw Lake in the enormous, virgin white pine forest surrounding Weslemkoon Lake. A few are known to be in Algonquin Park, and some could have wandered down from there through the continuous intervening forest. However, the area west of Mazinaw is wild and inaccessible enough to have maintained a small permanent population, especially in the white pine forest. Albert Spencer, who traps an area of about seventy square miles between Mazinaw and the pines of Weslemkoon, has never taken or seen a fisher in his area, although he thinks they may be present in the pines. Irving Brown states definitely that fishers are still present “about seven to eight

miles west of here in the virgin white pine wilderness around Weslemkoon Lake." The forest warden said that Brown was the best trapper hereabouts and knew more than anyone else about the mammals. The warden himself recalls having seen the last fisher taken in the Plevna region about forty years ago.

It is unfortunately true that the edges of the virgin pine forest are already being timbered during the winter, and it is only a matter of time before the forest will no longer exist. With its passing, the fisher will undoubtedly disappear also.

Mustela erminea cicognanii }
Mustela frenata noveboracensis } Both of these weasels are present, and are distinguished from each other on the basis of size by all trappers with whom I talked. A large white *frenata* from this region commands a good price on the fur market (\$3.75 top in 1949; \$2-\$3, depending on size, in 1950), hence they are conscientiously trapped. One example of *frenata*, too badly damaged to keep, was killed on the highway in 1949.

Mustela rixosa. According to Anderson (1946), the least weasel has not been taken in this part of Ontario. Evidence from local trappers is contradictory. Brown stated that weasels of all sizes had been accidentally trapped, but brought a good price "except for the very small one with a tail about an inch long, which was worthless." The forest warden stated that weasels were very abundant last year (1949-50) in the Plevna district with "very large, small, and little short-tailed ones." Albert Spencer, however, after hearing a careful description of the least weasel, said that he was totally unfamiliar with the animal, and that perhaps it did not occur around Mazinaw. The comments of these three reliable people are difficult to reconcile. Although in the face of the above statements it seems very unlikely, it is possible that Brown and the warden were referring to small females of *Mustela erminea cicognanii*.

Mustela vison vison. Minks, along with beavers, are the staples of the fur business in this region. They are quite common, and I noted mink tracks along most of the muddy streams or bogs investigated in 1949 or 1950, especially along the creek and alder bogs of area VI. One mink was seen in mid-afternoon crossing the highway towards the shore of Mazinaw Lake in 1950. With both mice and muskrats at very low levels, the mink must have to work hard and travel far for sufficient sustenance. Irving Brown (1950) says that the mink is getting scarce in the trapping area to the east and north of Mazinaw Lake. The forest warden reported them

plentiful in the Plevna district, and trapped a few in 1949 and 1950. The fur value of a large mink is now from eighteen to twenty-five dollars.

One mink is known to have been living on the west shore of Mazinaw in Area I several years ago when it attempted to carry off a kitten from an old trailer. It was driven off by the mother cat after a vicious fight.

Lutra canadensis canadensis. Otters reportedly have been uncommon in the past, but are now increasing. Albert Spencer trapped two in this area in the 1949-1950 season, but complained that they brought only fifteen dollars apiece. Irving Brown reports "loads of otter" and he recently has been trapping more otters than minks in his area, which includes the river and marshes north of Mazinaw Lake, as well as the east side of the lake.

It is evident that otters are quite abundant in the area, as one might expect from the numerous waterways, lakes, and ponds.

****Mephitis mephitis nigra***. Skunks are very common and are a pest on the highway and around cabins, where they visit every night looking for tidbits. Skunks were feeding largely on ripe blueberries in 1949. Several were killed on the highway, and more were seen alongside the road at night. Two half-grown young ones dwelt beneath our cabin in 1950 (area I), and one of these was trapped. An adult female was collected at Garbutt's camp in the same area. This skunk was found alive, but dying, on the edge of the lake with its head partially in the water. Its left, rear ankle joint was rigid, forcing it to walk on the tips of its toes. This identified it as the same animal which had been seen abroad on the hill above the lake (area VI), at noon two days previously. Autopsy revealed this animal to be extremely emaciated with atrophic muscles and no fat deposits whatsoever. No gross pathological changes were noted in any of the internal organs. Five porcupine quills, however were removed: three from beneath the skin, one from in the mandibular joint, and one from the fibrosed ankle. The ankle fibrosis, however, appeared to be from a much older lesion than the quill could account for, as old callouses on the foot testify. The animal had been lactating recently, and had three recent and three old right, and two recent and three old, left, uterine implantation scars. External parasites, mostly lice with a few ticks and fleas, were too numerous to count, and were estimated at at least a hundred for each square inch of skin over the entire body. The probable history of this skunk would be that she had raised at least one litter this spring, and some-

*Additional information concerning this species is included in the addendum after the bibliography, page 385.

time, probably after the birth of her young, encountered a porcupine. The quill in the jaw, after it had worked into the muscles and joint, probably prevented feeding. The hind-foot lesion was an old injury, and probably did not interfere much with her activities. The parasites most likely became so abundant as a result of her weakened condition. To the severe stresses of pregnancy, nursing, and inanition, was added the burden of parasites. Sinus worms were also present. All of these severe stressors resulted in the animal's death. In spite of all these alarming stimuli, the adrenal glands were found to have a quite high ascorbic acid content. This seems most paradoxical and cannot be explained, as exhaustion of her defense mechanisms, sufficient to cause death, most certainly would be expected to cause complete depletion of the adrenal ascorbic acid.

Vulpes fulva

Urocyon cinereoargenteus } Red foxes are present in abundance, and many sight records are in my possession. I neglected to inquire if gray foxes were also present while listening to the general complaints about foxes. The region is outside of the normal range of gray foxes, although Anderson (*loc. cit.*) reports that a gray fox had been taken six miles west of Kaladar, which would be in this general region. The foxes present, however, are probably red foxes with possibly a few grays.

Canis lupus lycaon. Wolves are relatively common in the Mazinaw district, although their known presence causes considerable local comment. In the spring of 1949, a pack appeared on the east shore of Mazinaw Lake, and were heard nightly. The number of animals in the pack is not known. The forest warden saw a wolf about five and a half miles below Denbigh on highway 41 during late May, 1950. He stated that these wolves are much darker than the dog-like wolves around Tweed, and claims they are "true timber wolves" and distinct from the others. The so-called wolves of Tweed, that he refers to, may be *Canis latrans*, or even wild dogs. This same warden has snared wolves in the Plevna district.

Two or three times each winter, wolves put in an appearance along the shores of Mazinaw Lake. The local opinion, given for what it may be worth, is that the wolves in the area come down from Algonquin Park. They are known to be common in the park, but this area probably supports its own wolves.

Lynx canadensis. The lynx is probably unknown in the territory, or at least extremely rare, judging from reports.

Lynx rufus. The bobcat is reportedly common, being frequently shot or trapped, contrary to Anderson's (1946) statement that they are extremely rare. No further information was obtained.

Marmota monax rufescens. Woodchucks are common and were frequently seen along the west shore of Mazinaw Lake above Cloyne. None was found dead on the highway in good enough condition for a specimen, although several had been run over. They all appeared small and quite red, although one picked up below Kaladar, Ontario, was very large. The density and length of the guard hairs on this animal were noticeably greater than on more southern animals.

One was seen along the edge of a pond in the center of a black spruce bog, and others were noted in the woods, although the roadside areas seemed to be a choice habitat and supported a large population. This may be apparent rather than real, since they are so much more easily seen.

Woodchucks were reportedly very abundant in 1950, more so than in 1949, and created havoc with the few truck gardens in the region.

Tamias striatus lysteri. Chipmunks are abundant throughout the second-growth, dry, rocky, deciduous woods, and many are killed daily on the highway. The only mammal recorded on top of the rocky bald (area IX) was a chipmunk feeding on blueberries. None was seen or captured in any of the cold habitats visited, but they were abundant around the shores of the lake. Of the four chipmunks obtained in 1949, two females and one male were immature. The third female was adult, but, having been run over, the reproductive status could not be determined other than that it was lactating.

Two chipmunks were picked up from the highway in good condition in 1950. Both of these were mature males with scrotal testes. The epididymes of both contained abundant spermatozoa. The testis of one contained all stages of spermatogenesis and showed no evidence of degenerative changes. The other had a reduced number of spermatids and secondary spermatocytes with giant cells composed of four or five secondary spermatocytes. These findings are most likely indicative of very early degenerative changes, and indicate the beginning of the cessation of breeding activity in at least the one male.

The population of chipmunks appeared to be about the same in 1950 as in 1949, as they were abundant in both years.

Tamiasciurus hudsonicus loquax. Anderson (1946) states that *loquax* and *hudsonicus* intergrade in the Algonquin Park region of southern Ontario, and consequently probably do so in the Mazinaw region also.

The red squirrel is one of the common mammals of the region, and was abundant in 1949. Not a habitat was visited which did not have red squirrels chattering from the trees, and many were seen crossing the highway or lying dead on it. They were especially abundant in mixed spruce-deciduous woods, and seemed to stay fairly close to the spruces. They evidently feed primarily on spruce seeds, as abundant cone cuttings testify. In one grove of black spruce (VIII) the daytime nest of a red squirrel was found. It was situated in a crotch, formed by a limb and the trunk, about twelve feet from the ground. Its outside diameter was about twelve inches, and in the center was a hollowed out, uncovered cavity four or five inches in diameter. The whole nest was composed of sticks, thickly lined with sphagnum and other soft mosses and plant fibers. In general it appeared like a finely constructed, large, bird nest. A rat trap was set in this nest after the squirrel was seen in it, but to no avail. A few feet away, and about twenty feet from the ground in the top of a small spruce, was its permanent, fully roofed-over nest, composed primarily of *deciduous* leaves.

In 1949 one lactating female was picked up from the highway.

In 1950, red squirrels in general were conspicuous by their absence. Not one was seen in any of the habitats visited or trapped in, and none was heard chattering. Several were seen either crossing the highway or lying dead on it, but few compared with 1949. Although no actual census was made, it was very evident that the "1950 population" of red squirrels was way down from 1949.

Red squirrels are shot on sight by the local residents, since there is no closed season on squirrels, but their numbers appear to be unaffected by the shooting, probably due to the enormous reserve range in which they are completely unmolested.

Sciurus carolinensis leucotis. Both "black" and "gray" squirrels are found in the district, although I did not see or collect any. Their fur brings a fair market price, and they are trapped or shot for this reason. They are reportedly "abundant."

Glaucomys sabrinus macrotis. Flying squirrels are known to be abundant even though none was collected. One nest was located in an old sapsucker hole about eight feet from the ground, in an aspen along the

shore of Mazinaw Lake. At Northbrook a pair of young ones had been captured about two weeks prior to our arrival in 1949, and were kept as pets. Their mother had been shot.

Castor canadensis. Beavers are one of the mainstays of the Mazinaw fur business, and were rapidly approaching extinction until a few years ago when the present Ontario trapping laws were put into effect. These have given the trapper an incentive not to "trap out" a locality by allowing only him to trap in his registered area. Beavers are now increasing throughout the territory. Mr. I. Brown has been taking many during the past two years (1949, 1950). Mr. A. Spencer had one beaver house on his area in 1947, but now (1950) has fifteen, and they are still increasing rapidly. He limits his catch to one beaver to each house in order to increase the population. He permits no destruction of dams or houses which benefits both the beavers and the muskrats. One of his colonies is in Essen's Lake, slightly west of area VI.

One beaver skull was collected from a trapper's "carcass dump."

Peromyscus maniculatus gracilis. Three males and three females were collected in 1949, and two juvenile females in 1950. One of the males had completely gray pelage, but was sexually mature with sperm in the epididymes and all stages of spermatogenesis in the testes. The other five "1949 mice" were adult with respect to both pelage and reproductive functions. One female had six 23 mm. embryos, and the mammary glands were post-lactationally enlarged and pigmented. These embryos would then represent at least her second litter of the year. The same is true for another which had seven recent and five old implantation scars, and was lactating. The third had ten uterine scars, and was lactating.

Of the three "1949 males," the testes of the two with adult pelage showed marked degenerative changes with very numerous giant cells of secondary spermatocytes and spermatids. Spermatids with vacuolar and chromolytic changes were abundant. These two animals were obviously regressing from full reproductive functioning. The male with juvenile pelage showed no degenerative changes, but the number of mature sperm was low.

Peromyscus m. gracilis was captured in such diverse areas as the middle of a sedge marsh (VIII), an alder bog (VI), a patch of spruces (II), a black spruce bog (X), a black ash-white cedar bog (III), and dry mixed woods (I). The common ecological denominator here is elusive, except that all habitats are either forested or wet, with a dense cover. The dry

open habitats produced none of these mice, nor did the sphagnum-Vaccinium bog (V). They were not as abundant as *leucopus* was in 1949, but two were caught in 1950 when no *leucopus* were caught.

***Peromyscus leucopus noveboracensis*.** This is probably the commonest mouse in the region. Twelve were taken in 1949, in every type of habitat trapped, but none was caught in 1950. Of the four females trapped, only one was adult with a perforate vagina, and this one was not pregnant, or lactating, or with implantation scars.

Of the eight males, two had abundant sperm in the epididymes. One of these possibly showed very early degenerative changes of the testes, while the other had a completely normal smear. One adult had a few sperm in the epididymes, and the testes showed marked degeneration with chromolysis of the spermatids and secondary spermatocytes. Two others, apparently recently matured, had few sperm in the epididymes, but showed no degenerative changes. The remaining three were juvenile with normal testicular smears and no spermatozoa in the epididymes. The testis of one of these contained a few small giant cells.

With only one of the five adult specimens of *Peromyscus l. noveboracensis* showing any marked degenerative changes in the testes, it appears that these mice either do not follow the same reproductive pattern as *Peromyscus m. gracilis*, or that the changes are slower in developing. The latter seems the likely answer, since at least some of the animals did show mild degeneration.

One of these mice was captured alive and fed blueberries and other foods so that it had a choice. At first only blueberries were placed in the cage and these were eaten. Then blueberries were put in the cage along with wintergreen berries, and were selected and eaten prior to the wintergreen berries. Berries of *Aralia* were left untouched, when put in alone or with other berries. A fly, a beetle, and a bumblebee were quickly seized and eaten in preference to any kind of berries, or bread, or prepared dog-food, or a cracker. The berries and an apple were selected in preference to any kind of prepared food. Black cherries were left untouched! Peanuts were nibbled, as were various grass seeds. A few stomach examinations revealed insects primarily, with spruce and pine seeds, and some undetermined vegetable remains. This mouse thrives well on a diet of dried dog-food and lettuce fourteen months after its capture.

Peromyscus l. noveboracensis has taken the place of the house mouse, and invades cottages extensively. Soap seems to be a dietary delicacy.

Neotoma sp. (?). Although this region is well out of the known range of the wood rat, it is possible that they are present. Mr. Fred Garbutt and his wife described two rats which their cat had brought in several years ago as being very distinct from *Rattus*, but about that size. The exceptional appearance was immediately noticed, and the animal was described as a rat with large deer-like ears resembling in general a deer-mouse, only larger. This information was entirely voluntary. Mr. Garbutt also saw a pair of these rats in a gravel pit about six years ago. Three rat traps placed in this pit for two nights caught nothing. The greater amount of fur on the tail of these rats was also mentioned. The fact that this information was wholly unsolicited lends validity to the description.

Synaptomys cooperi cooperi. Three of these animals were trapped in 1949; two in a sphagnum-Vaccinium bog (V), and the other in a run at the base of the rock face in a white cedar-black ash bog (III). They apparently were much more common prior to the extremely dry weather in the sphagnum-Vaccinium bog, as old droppings were found over the entire bog, and runs filled with old cuttings literally undermined the sphagnum of the whole area, most of which was quite dry at the time of trapping. Fresh feces and cuttings were found only in the remaining moist areas. One area in particular was littered with fresh green signs and cuttings, but no specimens of *Synaptomys* were captured here. The feces of the animal in the black ash-white cedar bog were black instead of the usual bright green, like those found in the open sphagnum bog. Due to the numerous and extensive spruce and sphagnum bogs in the area, *Synaptomys* is probably one of the more abundant mammals in the region. The period of rainless weather preceding the trapping period in 1949 may have reduced their numbers to some extent. None were caught in 1950.

The only female trapped had five minute embryos, as well as eight old implantation scars; so that the young *in utero* represented at least her second pregnancy of the year. The mammæ were enlarged and post-lactational.

Both males had abundant epididymal sperm. One of these had a few, very small degenerative giant cells in an otherwise normal smear. The testes of the other had numerous giant cells with up to fifteen nuclei of primary secondary spermatocytes, or spermatids. Late and early spermatids were markedly degenerate, and secondary spermatocytes were undergoing chromolysis. These findings are indicative that *Synaptomys* may undergo testicular regression in this region at this time of year.

Clethrionomys gapperi gapperi. Four of these voles, of which all were taken in 1949, came from around the edges of a white cedar-black ash bog under fallen logs and hummocks. They are probably restricted to such habitats, and on this basis this vole could not be considered a very abundant mammal in the region. A higher, less extensive, and less boggy spruce bog, although containing many fallen moss-grown logs and apparently similar microhabitats, did not yield any of these voles. None was caught in 1950.

One female was immature; the other was mature, lactating, and contained five right and no left implantation scars or corpora lutea. No transmigration of ova from one uterine horn to the other had taken place.

Both males were reproductively mature with abundant sperm in the epididymes. The testes of both of these red-backed mice showed marked degenerative changes with giant cells of up to thirty secondary spermatocytes or spermatids. Some giant cells involved primary spermatocytes. All individual spermatids had obvious degenerative changes. The picture was one of extremely rapid degeneration in early July at the height of reproductive activity.

Microtus pennsylvanicus pennsylvanicus. Ten specimens were captured in 1949; one in a small spruce bog, one in moist hardwoods, one in a dry, old field, one in a sedge marsh, and six in an alder bog and sedge marsh. All but one of these were taken in moist habitats, all but two of which were wooded. This seems somewhat contrary to the usual type of habitat associated with *Microtus pennsylvanicus*. In this region, where cultivated or fallow fields are scarce, *Microtus* apparently inhabits sites, represented by the wet alder and hardwood bogs and sedge marshes, which are the type they originally occupied prior to the invasion of agriculture. *Microtus* appears to occupy the wetter spots with deciduous cover, *Clethrionomys* the coniferous edges of bogs, and *Synaptomys* the extensive sphagnum bogs and their edges. No specimens of *Microtus* were trapped in 1950.

Three of these voles were very small, apparently fresh from a nest beneath a snarl of alder and white pine roots, as I surprised them while out wandering in the afternoon. They were caught while running frantically for cover. Possibly many small mammals are frightened into crossing traps. One of these was sexually mature (Christian, 1950b).

One fully grown male contained abundant sperm in the epididymis, the other was immature with no epididymal sperm, although the testes

were scrotal, but small. The adult mammal showed advanced degenerative changes similar to the *Clethrionomys* above with extremely abundant giant cells and vacuolar changes. It may be that adult males of *Microtus*, functionally active in the spring, undergo testicular regression at this time.

Ondatra zibethica. Muskrats are one of the principal furbearers in this region, but not as much so as farther south where there are more extensive habitats. Extensive cattail bogs are not numerous in this area; so the population of muskrats is scattered over numerous, small, suitable areas, such as marshy areas, shallow lakesides, small ponds, and the larger, slow-flowing streams. There was apparently a high population in 1949, but a severe drop had occurred by 1950, at the time of the spring trapping period. Albert Spencer had expected a catch of 500 muskrats, but caught only 150, or a little better than twenty-five percent of the expected catch. Irving Brown likewise stated that his catch was only twenty-five percent of the usual number, and further that the catch for the entire Lake Ontario region was down to a quarter of the usual catch. Apparently there was a general decrease of three quarters in the expected muskrat catch throughout the entire area. Muskrats are prime in late March or early April in this territory.

Mus musculus. The house mouse apparently has not invaded this area, partly due to the abandoning of most of the houses and cabins for a good part of the year, especially the winter.

Rattus norvegicus. According to reports, rats are found in Cloyne and about its dumps. By their destruction of foods stored in the cellars, they constitute a serious economic pest, and a real threat locally during the winter, when they move indoors.

Zapus hudsonius

Napaeozapus insignis }

The "jumping mice" are apparently not common in the area, as none was caught or seen. The "kangaroo" mouse was described very accurately by Mr. Fred Garbutt from one his dog had caught on the rocky, west shore of Mazinaw Lake two years ago. The animal was most likely *Zapus*, since Mr. Garbutt was certain there was no white tip on the tail, and the rest of his description was so accurate that it does not seem likely that he would have missed it. This is the only one he has seen in sixteen years of residence in this area.

Erethizon dorsatum dorsatum. Porcupines are very common in the area, and they were frequently killed on the highway. Due to their destructive habits and the danger to dogs, they are shot on sight. They are not, apparently, destructive to the pine or other timber trees in the area, as several people evinced surprise when told that porcupines are known to "bark" pines and other trees.

Lepus americanus americanus. The snowshoe hare is the common "rabbit" of the region, and was very common both in 1949 and 1950. Reportedly they were much more abundant in the latter year than in 1949. This abundance is impressive when all reports indicate that there were none to be seen in 1947, and very few in 1948. They were seen nightly along the highway in 1949, to which they were drawn by the calcium chloride. In 1950 the practice of spreading this chemical had been discontinued and work was progressing on the road, so not so many were seen. Numerous hare signs, forms, and runs were noted in all of the marshy areas trapped in both years, and the hares were flushed in habitats II and V in 1949. One lactating female hare was collected.

The ruffed grouse population in this area has exactly paralleled the hare population for at least the last four years, and they were abundant and accompanied by large coveys of young in both 1949 and 1950.

Odocoileus virginianus borealis. Deer are relatively abundant, though much less common than in irruptive areas of the United States, such as Pennsylvania. The deer average larger than those further south, and 250-pound bucks are not at all uncommon. At present there is much local agitation to have no closed season on deer due to crop damage. Should this come to pass, I doubt if the deer would suffer very much, as most of the country is relatively inaccessible and extremely difficult to hunt. Even now most deer hunting is done with dogs, which would probably be disastrous elsewhere.

Alces americanus. Moose are uncommon in the summer, but are frequently seen in the other three seasons. Several were seen along Mazinaw Lake in 1949, and the fire rangers see them from time to time back in the bush. Moose tracks were seen about two miles west of Mazinaw Lake about two weeks before the trapping period of 1950. They are most frequently seen in the spring.

IV. DISCUSSION OF POPULATIONS

From the foregoing account it is evident that the small mammal population in the Mazinaw region decreased considerably in 1950 from the previous year. Examination of the trapping summaries in the section on habitats reveals the marked decrease in trap line productivity in 1950 as compared to 1949. It is true that trap-night figures will not give a quantitative picture of an area, but they will give a fairly accurate picture of relative changes under the conditions of this study. These conditions are that one person did all of the trapping, reducing the subjective variables of trap setting to a minimum; the same period of time is involved in both years; only three of the ten habitats were trapped in both years, but in both the same general area was involved; an effort was made to set the traps in as nearly the same concentration and manner in 1950 as in the preceding year; traps were moved often enough to avoid catching more than a minimum of stragglers; and the same bait was used each year. For the sake of uniformity, the figures for 1950 for area I have been omitted from the succeeding discussion, as the rat traps used there may have altered the situation. I believe that the following figures represent a valid picture of the relative population changes from 1949 to 1950.

In 1949, 54 small mammals of all species were trapped in 870 trap-nights, or one catch per 16 trap-nights. In 1950, only 12 mammals were caught in 1,127 trap-nights, or 1 catch in 94 trap-nights. This means that the small mammal population for the Mazinaw region in 1950 was only 17% of the 1949 level. The following figures give the breakdown into species using trap-night figures. The long-tailed shrews are lumped in one group, as are the mice and voles. The *Soricidæ* were 108% of the 1949 level which, considering the number of shrews involved, represents an unchanged population. *Blarina* was down 75% from its 1949 figure, and the mice and voles, represented by one *Peromyscus m. gracilis*, were down 98%. The population drop, then, was due to *Blarina*, *Peromyscus m. gracilis*, *Peromyscus l. noveboracensis*, *Symptomys*, *Clethrionomys*, and *Microtus*. A similar, but not so marked, drop in population was experienced in census lines from the spring of 1949 to the spring of 1950 at Philadelphia, Pa. In this instance, *Blarina* dropped 71%, *Microtus* 86%, and *Peromyscus l. noveboracensis* increased 67% of the 1949 levels, to make an overall decrease of 48%. The principal difference seems to be in *Peromyscus*, which decreased in Ontario and increased in Pennsylvania. *Peromyscus* was in phase with the other small mammals (other than

shrews and moles) in Ontario, while it was out of phase with the others in Pennsylvania. The principal reason for bringing these figures in at this point is to show how much more severe the drop was in Ontario than it was 400 miles further south, and at 1,000 feet lower altitude, although the drop was experienced simultaneously in both places.

It is interesting that the small mammal decline coincided with the decline of muskrats throughout southern Ontario, where the spring catch was 25% of the expected level. However, snowshoe hares, ruffed grouse, woodchucks, and the predatory fur bearers of the region, were all abundant and reportedly increased over 1949 levels. Red squirrels were obviously way down from the 1949 level in this region, but no estimate can be made of the degree of the decline. This probably is a local change, as they have reportedly remained abundant in Algonquin Park (Fowle, 1950), although the other declines were also noted there. Based on sight observations, chipmunks were apparently at the same high level in 1950 as in 1949. Due to present Ontario trapping laws, beavers are increasing rapidly, and should reach high levels in the near future.

The Ontario laws license each trapper to trap in a specified area. No one else may trap in this area, and the trapper may keep it as long as he traps in it. This has added a powerful incentive for the trappers to be conservationally minded. The number of animals which may be removed without endangering the next year's catch is checked by each trapper, so that complete removal of all muskrats and beavers has ceased. In most instances, the trappers have been planting wild rice and cattails to increase muskrat forage. Also, wardens are assisted in the apprehension of poachers by the trappers concerned. All in all, these trapping practices have produced healthy results in the region, and have won the support of the trappers, but it remains to be seen what the final results will be in terms of population dynamics. In spite of this care, the muskrats declined, and it is conceivable that beavers, if allowed to increase excessively, will become cyclic and experience severe declines (Christian, 1950c).

V. DISCUSSION OF DATA ON REPRODUCTION IN RELATION TO POPULATION DYNAMICS

As a preamble to the discussion of the Canadian data it is necessary to discuss briefly some findings from the Philadelphia area in April, 1949, and April, 1950. In the spring of 1949, as already mentioned, the population of small mammals in the Philadelphia region was high, while in the same period of 1950 the population of small mammals, except *Peromyscus*,

was at a low ebb. Smears of the testes were made of twelve adult male mammals (*Microtus*, *Blarina*, *Peromyscus*) trapped in this area in 1949. The testes of nine of these animals showed advanced degenerative changes with very numerous giant cells of up to thirty degenerate spermatids, secondary spermatocytes, or occasionally primary spermatocytes. Chromolytic changes were noted in a large portion of the spermatids and secondary spermatocytes. In some there was a marked reduction of spermatozoa and spermatids. The testes of all of these mammals were scrotal, and some or many spermatozoa were found in the epididymes. Two animals had mild degenerative changes with fewer and smaller giant cells, while one had a normal smear. In the spring of 1950, however, only one testicular smear in eight showed any marked degenerative changes, although the time of the year and the climatic conditions were about the same.

In a previous paper (Christian, 1950c), I discussed the possible effect of high population stresses on the reproductive potential of the species involved. It seems likely that the severe stresses attending the spring breeding season of a high population level seen in 1949 account for the degenerative changes found in the testicular smears. By contrast the normal smears of 1950 reflect a low population with a minimum of stressors. That various environmental, psychological, or traumatic stresses may produce these testicular changes, of which giant cell formation is characteristic, now seems well established (Selye, 1950). This degeneration is apparently caused by the withdrawal of pituitary gonadotrophin (hypophysectomy is the most potent producer of these changes) to favor the production of adrenocorticotrophin. The census taken in the fall in the same area revealed the population to be at the same level as in the early spring, instead of being increased. This would be predictable from the appearance of the spring testes, since the degenerative changes were indicative of a lower reproductive potential. Whether these changes would result in a complete cessation of breeding in each animal, or only in a reduction in the number of sperm produced, would probably depend on the severity of the stress in the animal. Even though sperm were produced, a lower count could be too low for successful fertilization. The effects of these factors on the female in the wild is not known, but experimental stress causes the ovaries of white rats to atrophy and the animal to go into permanent anestrus (Selye, 1939).

In contrast with the testes of mammals taken at Philadelphia in early spring of 1949 and 1950, adult males of *Sorex cinereus*, *Blarina*, *Tamias*,

Peromyscus m. gracilis, *Synaptomys*, *Clethrionomys*, and *Microtus* taken in Ontario, all showed marked degenerative changes of the testes during the first two weeks of July in both years. *Peromyscus l. noveboracensis* was an exception in that only two of five with sperm in the epididymes, and one of three juvenile males showed any degenerative changes. Degeneration was especially severe in the microtines and soricids. Five adult males of *Blarina* were examined in the two years, and four of these showed degenerative changes. Adults of the other mammals were examined in one year or the other; *Sorex* and *Tamias* in 1950, and the others in 1949. All of the adults of *Sorex cinereus*, *Peromyscus m. gracilis*, *Synaptomys*, *Clethrionomys*, and *Microtus* examined showed degenerative changes.

It would seem, since the testicular changes were found in both years of peak and low populations in the Ontario mammals, that something is working on all species other than the stress effects of a high population, as has been suggested for the "1949" Philadelphia animals. Since all species are involved, and the degenerative changes range from none (in *Peromyscus l. noveboracensis*) to advanced stages, it would seem that the causative agent had probably not been operative for very long. Logically, the passing of the summer solstice with the resultant decreasing day-lengths would appear to be the causative factor. The relation of light and other exteroceptive factors to reproduction has been previously referred to (Christian, 1950c), and the subject has been well summarized by Burrows (1949). It is clear that the daily added light increment is the important element in bringing an animal to full reproductive activity and to maintaining it, while decreasing light resulted in testicular regression in every case investigated. Since stress probably can be ruled out as a result of similar findings in years of divergent populations, light must be the factor involved in this early-summer male reproductive regression found following the summer solstice in all of the species of small mammals considered. The timing certainly seems more than coincidental.

The possibility of this being an artifact resulting from autolytic changes while the animal was in the trap has been ruled out by experiments in which one testis of a normal mouse was "smeared" immediately after death and the other at various intervals after standing at from 70° to 80°F. No differences between the smears of the two testes were observed at any time interval up to eight hours. Technical artifacts have been eliminated by frequent smears of laboratory mice, which were normal in every instance, as well as by comparison with normal smears in the wild-trapped mammals.

It is well known that the spring breeding season reaches a peak, and is followed by a sharp fall in reproductive activity, best expressed as the per cent of females which are pregnant. Coventry (1937) reviews this situation in connection with his own material from Ontario, and explains the fall in the per cent of pregnant females captured, by postulating a decrease in activity as a result of almost one hundred per cent of pregnancies earlier in the season. The present testicular findings indicate, however, that the testes in the males which were adult during the spring breeding season undergo regression following the solstice. This time would be extended three weeks for pregnant females; also, female reproductive activity may be similarly affected. The gradually increasing but low level of pregnancies during the balance of the summer could well be accounted for by young of the year reaching maturity, or by a few adults which did not regress markedly. C. D. Fowle (1950) reports that few, if any, pregnant individuals of *Sorex cinereus* or *Blarina* are taken after the middle of July in Algonquin Park, Ontario. Coventry's (1937) peaks of per cent pregnancies for *Peromyscus m. gracilis* and *Clethrionomys g. gapperi* from Temagami, Ontario, correspond exactly with the present findings, if conception is dated at an average of two weeks prior to his peak (pregnancy first being grossly detectable at six days with a twenty-one day gestation period).

The present material indicates, then, that the spring breeding season is terminated by the decreasing day-lengths following the summer solstice in *Sorex cinereus*, *Blarina brevicauda talpoides*, *Tamias striatus lysteri*, *Peromyscus maniculatus gracilis*, *Peromyscus leucopus noveboracensis* (at least to some extent), *Synaptomys cooperi*, *Clethrionomys gapperi*, and *Microtus pennsylvanicus* from the Mazinaw Lake region of Ontario.

In view of the above discussion it is evident that an actual die-off is not essential for a marked population decline. All that would be required to seriously curtail the population would be sufficient stress to markedly reduce reproductive activity of adults from the start of the spring breeding season until the summer solstice. With this occurring, along with a normal or increased death rate, the number of animals produced would be markedly reduced, and consequently the number surviving the succeeding winter to breed in the following spring would be correspondingly reduced. A population decline of this type would be more likely to occur in more temperate regions, while the actual marked die-off would be expected in the more northern regions which have severer stresses. This would certainly be true for the limited species-food ecology of the sub-

arctic. A greater reproductive potential farther north (Christian, 1950c) might still be expected, with a much more intense activity during the spring breeding season. Some evidence of this has been noted, but it is, as yet, inconclusive.

BIBLIOGRAPHY

ANDERSON, R. M.

1946. Catalogue of Canadian Recent mammals. Nat. Mus. Can., Bull. 102, Biol. ser., 31, pp. v + 238.

BURROWS, H.

1949. Biological actions of sex hormones. 2nd Ed. Cambridge Univ. Press. pp. ix + 615.

CHRISTIAN, J. J.

- 1950 a. A field method of determining the reproductive status of small male mammals. Journ. Mammal., 31, pp. 95-96.
1950 b. A precocious male *Microtus pennsylvanicus*. Journ. Mammal., 31, pp. 195-196.
1950 c. The adreno-pituitary system and population cycles in mammals. Journ. Mammal., 31, pp. 247-259.

COVENTRY, A. F.

1937. Notes on the breeding of some Cricetidae in Ontario. Journ. Mammal., 18, pp. 489-496.

FOWLE, C. D.

Personal communication.

HALLIDAY, W. E. D.

1937. A forest classification for Canada. Canad. Dept. Mines and Resources, Forest Service Bull., 89, pp. 1-50.

HAMILTON, W. J., Jr.

1943. The mammals of eastern United States. Comstock Publ. Co., Ithaca. Pp. 1-432.

JACKSON, H. H. T.

1928. A taxonomic review of the American long-tailed shrews. U. S. Dept. Agric., Bur. Biol. Surv., N. A. Fauna No. 51, pp. 1-238.

SELYE, H.

1939. The effect of adaptation to various damaging agents on the female sex organs in the rat. Endocrin., 25, pp. 667-672.
1950. Stress. Acta Inc., Montreal. pp. xx + 822.

ADDENDUM

The normal skunk (*Mephitis mephitis nigra*) adrenal is a rounded, unlobulated, somewhat biconcave disc. The zonation is similar to that found in other mammals. The glomerulosa, however, is distinctly divided from the outer fasciculata by a thin connective tissue septum which is clearly defined in ordinary preparations, and is richly invested with vascular channels. The glomerulosa of the normal animal is about a fifth the width of the entire cortex. Dividing the reticularis from the medulla is a thick, well-defined hyaline connective tissue septum containing numerous veins and small blood sinuses. This connective tissue boundary is denser and much more pronounced than has been seen by the writer in any other species of mammal. The medulla contains the usual granule-filled chromaffine cells. The microscopic appearance of the cortical cells is similar to that seen in other normal, healthy animals.

In the dying female skunk from Mazinaw Lake, Ontario, the cells of the glomerulosa are shrunken and the nuclei pyknotic. In some areas the glomerulosa is replaced by small foci of hyaline necrosis. The thin band of connective tissue between the glomerulosa and fasciculata is not seen. The changes in the fasciculata are very marked. The outer half of this zone is necrotic, having formed a coalesced mass of granular cytoplasm containing pyknotic and karyorhetic nuclei. In a few places this zone of necrosis is interrupted by a few cords of relatively normal appearing fasciculata cells. Central to this band of necrosis the cells of the inner half of the fasciculata and the entire reticularis are shrunken, and the sinusoids are widely dilated. The cytoplasm of approximately half of these cells have the characteristic foamy appearance of fine vacuolation. In several places, involving about one sixth of the entire gland area, wedge-shaped zones of hyaline necrosis extend from the medulla to the outer fasciculata. There has been extensive hemorrhage into these zones of necrosis, and all zones are heavily congested.

The connective tissue separating the medulla from the cortex is enormously widened, almost the entire width of the cortex in one gland and ten to thirty-fold in the other. This band and all of the thinner connective tissue septa are hyalinized, and scattered through them are large phagocytes filled with ingested red blood cells. Arteries, other than a few in the areas of hyalinosis, appear to be normal.

The medullary chromaffine cells are small, deeply staining, and have relatively little cytoplasm, which is free of the characteristic baso-

philic granules. The nuclei appear normal with distinct nucleoli. Throughout the medulla, however, there are islands of cortical cells replacing over half of the chromaffine tissue. A few of these islands are glomerulosa cells, but the majority are fasciculata cells containing abundant small cytoplasmic vacuoles. None of these misplaced cortical cells are necrotic, and appear to be normally functional.

Both of the adrenals of this skunk present the same appearance, both exhibiting the same marked degree of destruction and cortical metaplasia. The degree of damage is suggestive of the amount seen in cases of clinical Addison's disease; and, although there were limited numbers of normal appearing cortical cells, the destruction of both the cortex and the medulla must have been severe enough to seriously reduce the functional capacity of the glands, as well as impair the circulatory supply. I have already indicated that a semi-quantitative test showed these adrenals contained a moderate amount of ascorbic acid. This can only be accounted for by hyperactivity of the remaining normal cells.

The marked degree of hyalinosis, along with hyperplasia and metaplasia, which has occurred in these glands supports the previous assumption of long-standing stress with the more acute necrosis resulting from the final exhausting demands on the gland. The microscopic appearance of the adrenals of this skunk is a striking demonstration of the effect of excessive stress in a wild mammal.